

**INTELLIGENT MODULAR SERVER MANAGEMENT SYSTEM FOR
SELECTIVELY OPERATING AND LOCATING A PLURALITY OF COMPUTERS**

1 FIELD OF THE INVENTION

2 The present invention relates generally to a remote
3 computer or server management system for coupling a series
4 of remote computers to one or more user workstations
5 allowing for efficient location, error detection and/or
6 general status indication of the remote computers or
7 servers. In particular, computer interface modules
8 connected to the remote computers or servers include a
9 signaling circuit to emit a signal, which may be an audible
10 or visual signal, upon detection of a problem or upon
11 receipt of a signal command from a user trying to locate a
12 particular remote computer. Alternatively, the signaling
13 circuit may transmit a message to the user workstation to
14 inform the user of a problem, general status (e.g., of
15 firmware upgrade), etc., which may be displayed on the
16 user's video monitor.

17

18 BACKGROUND OF THE INVENTION

19 In a typical computer environment, a Local Area
20 Network (LAN) allows for one or more computer servers to be
21 connected to several computers such that the resources of
22 each server are available to each of the connected

1 computers. In this system, a dedicated keyboard, video
2 monitor and mouse may be employed for each computer and
3 computer server.

4 To maintain proper operation of the LAN, the system
5 administrator must maintain and monitor the individual
6 computer servers and computers. This maintenance
7 frequently requires the system administrator to perform
8 numerous tasks from the user console located at the server
9 or computer. For example, to reboot a computer or to add
10 or delete files, the system administrator is often required
11 to operate the server or computer from its local user
12 console, which may be located at a substantial distance
13 from the system administrator's computer. Therefore, to
14 accomplish the task of system administration, the system
15 administrator must often travel far distances to access the
16 local user consoles of remotely located servers and
17 computers. As an alternative to physical relocation of the
18 system administrator, dedicated cables may be installed
19 from each remotely located server and computer to the
20 system administrator's user console to allow the system
21 administrator to fully access and operate the remote
22 computer equipment. However, such an alternative requires
23 substantial wiring and wire harnessing, both of which may
24 require tremendous cost. Additionally, as the distance

1 between the system administrator's user console and the
2 remote computer equipment increases, a decrease in the
3 quality of the transmitted signal often results. Thus,
4 dedicated cables between the system administrator's user
5 console and remote computer equipment may not be a feasible
6 alternative.

7 In addition to system administration, space is also an
8 important concern for many computer networking
9 environments, especially large-scale operations such as
10 data-centers, server-farms, web-hosting facilities, and
11 call-centers. These environments typically require space
12 to house a keyboard, video monitor, and mouse for each
13 piece of computer equipment in addition to all of the
14 wiring required to connect and power these components.
15 Furthermore, space is also required to house all of the
16 network interface wiring. As more equipment is added to a
17 computer network, it becomes more probable that the space
18 required for the equipment and associated cabling will
19 exceed the space allotted for the network. Therefore,
20 network architecture, equipment size and available space
21 are important issues when designing an effective computer
22 network environment.

23 One method of reducing the amount of space required to
24 house a computer network is to eliminate any equipment

1 (i.e., keyboard, video monitor, cursor control device,
2 etc.) that is not essential for proper operation of the
3 computer network. Elimination of this equipment also
4 eliminates the wiring associated with such equipment. This
5 equipment, and associated wiring, may be eliminated if a
6 system administrator is able to access the remote computers
7 from one user console, thereby eliminating the dedicated
8 equipment and the associated wiring for each remote
9 computer. Elimination of this unnecessary equipment
10 decreases the amount of space required for computer network
11 environments.

12 A keyboard, video monitor, and mouse ("KVM") switching
13 system may be utilized to allow one or more user
14 workstations to select and control any one of a plurality
15 of remote computers via a central switching unit. Such
16 systems are well known in the art and have been used by
17 system administrators for at least 10 years. Specifically,
18 a KVM switching system allows a system user to control a
19 remote computer using a local user workstation's keyboard,
20 video monitor, and mouse as if these devices are directly
21 connected to the remote computer. In this manner, a system
22 user may access and control a plurality of remote
23 computers, such as servers, from a single location (i.e.,
24 the location of the user workstation). The system user may

1 select a specific remote computer to access or control
2 using any one of a variety of methods known in the art
3 including pushing a button on the face of a switching
4 system component that corresponds with the desired remote
5 computer, selecting the computer from a list displayed on a
6 switching system component's LCD or LED display, pressing
7 one or more hot keys on the local user workstation's
8 keyboard (e.g., F1, ALT-F1, F2, etc.), selecting the remote
9 computer from a list displayed on the user workstation's
10 monitor by pointing to it or scrolling to it using the user
11 workstation's keyboard and/or mouse, etc.

12 However, an additional problem arises in large-scale
13 computer operations where the peripheral equipment is
14 removed from each computer. Since the display unit of each
15 computer is remotely located at a workstation console, it
16 often is difficult for a user to physically locate a
17 desired computer to perform upgrades or maintenance not
18 possible from the user's local keyboard, video, and mouse.
19 A need therefore exists for an alarm and location device
20 which enables users, such as system administrators, to
21 easily locate computers in large-scale operation
22 environments.

23 The following references, which are discussed below,
24 were found to relate to the field of computer management

1 systems: Asprey U.S. Patent No. 5,257,390 ("Asprey '390
2 patent"), Asprey U.S. Patent No. 5,268,676 ("Asprey '676
3 patent"), Asprey U.S. Patent No. 5,353,409 ("Asprey '409
4 patent), Perholtz et al. U.S. Patent No. 5,732,212
5 ("Perholtz"), Chen U.S. Patent No. 5,978,389 ("Chen '389
6 patent"), Chen U.S. Patent No. 6,119,148 ("Chen '148
7 patent"), Fujii et al. U.S. Patent No. 6,138,191 ("Fujii"),
8 Beasley U.S. Patent No. 6,345,323 ("Beasley"), and Wilder
9 et al. U.S. Patent 6,557,170 ("Wilder").

10 The Asprey '390 patent, filed on July 26, 1991 and
11 issued on October 26, 1993, discloses an extended range
12 communications link for coupling a computer to a mouse,
13 keyboard, and/or video monitor located remotely from the
14 computer. The end of the link that is coupled to the
15 computer has a first signal conditioning network (i.e., a
16 network of circuitry that dampens the ringing and
17 reflections of the video signals and biases them to a
18 selected voltage level) that conditions the keyboard, video
19 monitor and mouse signals. Conditioning the video monitor
20 signals includes reducing their amplitude in order to
21 minimize the amount of "crosstalk" that is induced on the
22 conductors adjacent to the video signal conductors during
23 transmission of the video signals. This first signal
24 conditioning network is coupled to an extended range cable

1 having a plurality of conductors that transmits the
2 conditioned signals and power and logic ground potentials
3 to a second signal conditioning network (i.e., a network of
4 circuitry that terminates the video signals using a voltage
5 divider and amplifies them), which restores the video
6 signals to their original amplitude and outputs them to a
7 video monitor.

8 The Asprey '676 patent, filed on March 5, 1990 and
9 issued on December 7, 1993, discloses a communications link
10 for use between a computer and a display unit, such as a
11 video monitor, that allows these two components to be
12 located up to three hundred (300) feet apart. An encoder
13 located at the computer end of the communications link
14 receives analog red, green and blue signals from the
15 computer and inputs each signal to a discrete current
16 amplifier that modulates the signal current. Impedance
17 matching networks then match the impedance of the red,
18 green and blue signals to the impedance of the cable and
19 transmit the signals to discrete emitter-follower
20 transistors located at the video monitor end of the cable.
21 These transistors amplify the signal prior to inputting it
22 to the video monitor. Concurrently, the horizontal
23 synchronization signal is inputted to a cable conductor and
24 its impedance is not matched to the impedance of the cable,

1 thereby allowing the conductor to attenuate the horizontal
2 synchronization signal and reduce noise radiation.

3 The Asprey '409 patent, filed on July 19, 1990 and
4 issued on October 4, 1994, discloses an extended range
5 communications link for transmitting transistor-transistor
6 logic video signals from a local computer to a video
7 monitor located up to a thousand feet (1,000) from the
8 computer. The link includes a first signal conditioning
9 circuit (i.e., a circuit that reduces the amplitude of the
10 video signals, biases them to a selected potential, and
11 applies them to discrete conductors of an extended cable)
12 located at the computer end of the link for conditioning
13 the received signals and transmitting them via the extended
14 cable to a second signal conditioning circuit. The second
15 signal conditioning circuit (i.e., a circuit that utilizes
16 a threshold or pair of thresholds to effect reconstruction
17 of the video signals prior to applying the signals to a
18 video monitor) receives the transmitted video signals prior
19 to inputting them to the video monitor. According to the
20 Asprey '409 patent, performance of this process reduces the
21 appearance of high frequency video noise on the keyboard
22 clock conductor of the transmission cable, thereby
23 preventing keyboard errors.

1 Perholtz, filed on January 13, 1994 and issued on
2 March 24, 1998, discloses a method and apparatus for
3 coupling a local user workstation, including a keyboard,
4 mouse, and/or video monitor, to a remote computer.
5 Perholtz discloses a system wherein the remote computer is
6 selected from a menu displayed on a standard personal
7 computer video monitor. Upon selection of a remote
8 computer by the system user, the remote computer's video
9 signals are transmitted to the local user workstation's
10 video monitor. The system user may also control the remote
11 computer utilizing the local user workstation's keyboard
12 and monitor. The Perholtz system is also capable of bi-
13 directionally transmitting mouse and keyboard signals
14 between the local user workstation and the remote computer.
15 The remote computer and the local user workstation may be
16 connected either via the Public Switched Telephone System
17 ("PSTN") and modems or via direct cabling.

18 The Chen '389 patent, filed on March 12, 1998 and
19 issued on November 2, 1999, discloses a device for
20 multiplexing the video output of a plurality of computers
21 to a single video monitor. The system of Chen includes
22 three sets of switches for receiving the red, green, and
23 blue components of the video signals from each computer.
24 To select the video output of a specific computer for

1 display on the video monitor, a user inputs two video
2 selecting signals into a control signal generating circuit.
3 Depending upon the inputted video selecting signals, the
4 control signal generating circuit produces an output signal
5 corresponding to the selected video output. Thereafter, a
6 control signal is generated that indexes the three sets of
7 switches to switch the video signals being output by the
8 desired computer to the single video monitor. The three
9 sets of switches transfer the incoming video signals to
10 three sets of switch circuits and current amplifying
11 circuits that provide input and output impedance matching,
12 respectively. The tuned video signals are then displayed
13 on the single video monitor.

14 The Chen '148 patent, filed on July 29, 1998 and
15 issued on September 12, 2000, discloses a video signal
16 distributor that receives processes and distributes video
17 signals received from one or more computers to a plurality
18 of video monitors. The video signal distributor includes
19 three transistor-based voltage amplifying circuits to
20 individually amplify the red, green and blue video signals
21 received from each computer prior to transmitting these
22 signals to a video monitor. The video signal distributor
23 also includes a synchronization signal buffering device
24 that receives horizontal and vertical synchronization

1 signals from each computer and generates new
2 synchronization signals based upon the quantity of video
3 signals that are output to the video monitors.

4 Fujii, filed on February 10, 1998 and issued on
5 October 24, 2000, discloses a system for selectively
6 operating a plurality of computers that are connected to
7 one common video monitor. The Fujii system includes a data
8 input device for entering data in any one of the plurality
9 of connected computers. The system also includes a main
10 control circuit, which is connected to the data input
11 device, and a selection circuit for providing the entered
12 data and receiving the video signals from the selected
13 computer. A user selects a remote computer by supplying
14 the command code associated with the desired remote
15 computer utilizing the keyboard and/or cursor control
16 device. A selection circuit receives the inputted commands
17 and identifies the selected computer. The selection
18 circuit then sends a signal indicative of the selected
19 remote computer to a main control circuit, which interfaces
20 the keyboard, video monitor, and cursor control device to
21 the selected remote computer.

22 Beasley, filed on June 9, 2000 and issued on February
23 5, 2002, like Perholtz, discloses a specific implementation
24 of a computerized switching system for coupling a local

1 user workstation, including a keyboard, mouse and/or video
2 monitor, to one of a plurality of remote computers. In
3 particular, a first signal conditioning unit, located at
4 the local user workstation, includes an on-screen
5 programming circuit that displays a menu of connected
6 remote computers on the video monitor of the user
7 workstation. The user selects the desired computer from
8 the list using the local user workstation's keyboard and/or
9 mouse. To activate the menu, a user depresses, for
10 example, the "printscreen" key on the workstation's
11 keyboard. This causes an overlaid video display to appear
12 on the workstation's video monitor that is produced by the
13 onscreen programming circuit. A user may then select a
14 desired remote computer from the overlaid menu.

15 According to Beasley, the on-screen programming
16 circuit requires at least two sets of tri-state buffers, a
17 single onscreen processor, an internal synchronization
18 generator, a synchronization switch, a synchronization
19 polarizer, and overlay control logic. The first set of
20 tri-state buffers couples the red, green, and blue
21 components of the video signals received from the remote
22 computer to the video monitor. When the first set of tri-
23 state buffers are energized, the red, green, and blue video
24 signals are passed from the remote computer to the

1 workstation's monitor through the tri-state buffers. When
2 the first set of tri-state buffers are not active, the
3 video signals from the remote computer are blocked.
4 Similarly, the second set of tri-state buffers couples the
5 outputs of the single onscreen processor to the leads that
6 connect to the monitor's color inputs. The overlaid video
7 image produced by the onscreen processor, namely a Motorola
8 MC141543 onscreen processor, is limited to the size and
9 quantity of colors that are available with the single
10 onscreen processor. In other words, the Beasley system is
11 designed for one mode of operation in which the overlaid
12 video is sized for a standard size computer monitor and not
13 a wall-size or multiple monitor type video display. When
14 the second set of tri-state buffers is energized, the video
15 output of the on-screen programming circuit is displayed on
16 the workstation's video monitor. When the second set of
17 tri-state buffers is not active, the video output from the
18 on-screen programming circuit is blocked.

19 The on-screen programming circuit disclosed in Beasley
20 also produces its own horizontal and vertical
21 synchronization signals. To dictate which characters are
22 displayed on the video monitor, the CPU sends instructional
23 data to the onscreen processor. This causes the processor

1 to retrieve characters from an internal video RAM that are
2 to be displayed on the workstation's video monitor.

3 During operation, a remote computer is chosen from the
4 overlaid video display. Thereafter, the first signal
5 conditioning unit receives keyboard and mouse signals from
6 the workstation and generates a data packet for
7 transmission to a central cross point switch. The cross
8 point switch routes the data packet to a second signal
9 conditioning unit coupled to the selected remote computer.
10 The second signal conditioning unit then routes the
11 keyboard and mouse command signals to the keyboard and
12 mouse connectors of the remote computer. Video signals
13 produced by the remote computer are routed through the
14 second signal conditioning unit, the cross point switch,
15 and the first signal conditioning unit to the video monitor
16 at the local user workstation. The horizontal and vertical
17 synchronization video signals are encoded on one of the
18 red, green or blue video signals to reduce the quantity of
19 cables required to transmit the video signals from the
20 remote computer to the local workstation's video monitor.

21 Wilder, filed on May 5, 1998 and issued on April 29,
22 2003, discloses a keyboard, video monitor, mouse, and power
23 ("KVMP") switching system having an on screen display
24 circuit coupled to a user workstation for providing an

1 interface to the KVMP switch. A first set of switching
2 circuits coupled to a plurality of computers and the on
3 screen display circuit allows a user to access and control
4 any of the computers using a keyboard, video monitor, and
5 mouse attached to a user workstation. A second set of
6 switching circuits coupled to the power supply of each
7 computer and the on screen display circuit allows a user to
8 control the electrical power to each computer utilizing an
9 on screen display. To select a remote computer utilizing
10 the Wilder system, a user activates the on-screen display
11 by entering a hot key either with the keyboard and/or
12 cursor control device. The on-screen display initially
13 prompts a user to enter a username and password. Once the
14 user has been verified, the user is provided a menu
15 containing a list of all attached computers and a menu to
16 control the power supply to each computer. The user
17 utilizes the keyboard and/or cursor control device to
18 select the desired remote computer or power settings from
19 the on-screen display menu. Wilder incorporates a single
20 onscreen processor for generation of the remote computer
21 selection menu.

22 Currently, many methods are known in the art of
23 locating remote objects. Typically, these systems utilize
24 a wireless transmitter device capable of emitting a signal

1 and a responder device that produces an audible tone in
2 response to the signal emitted by the transmitter. These
3 systems are usually utilized to locate commonly misplaced
4 objects. For example, a person may affix a responder
5 device to a set of house keys. If the house keys were ever
6 misplaced, they could easily be located by utilizing the
7 transmitter device to cause the responder device to produce
8 an audible tone. The lost house keys could then easily be
9 found by locating the source of the audible tone. Such
10 references include Anderson et al. U.S. Patent No.
11 4,101,873, Kipnis U.S. Patent No. 5,677,673, Trivett U.S.
12 Patent No. 6,535,125 and Knaven U.S. Patent Number
13 6,501,378.

14 In view of the foregoing, a need clearly exists for a
15 reliable, efficient, modular, remote computer management
16 and switching system that allows information technology
17 personnel to easily manage, maintain and locate a plurality
18 of computers or servers. Such a system should allow a user
19 to easily locate any one of a plurality of remote computers
20 or servers by selectively causing a signaling circuit in a
21 device attached to the remote computers to emit an audible
22 or visual signal. The system may also be utilized to
23 notify users about the status of an upgrade or other such
24 maintenance tasks. In this manner, it is more efficient

1 for information technology personnel or administrators to
2 be notified of system errors. The system will aid in both
3 small-scale computer centers and large-scale operations
4 such as data-centers, server-farms, web-hosting facilities,
5 and call-centers.

6

7 SUMMARY OF THE INVENTION

8 The present invention relates to a remote computer or
9 server management system for coupling a series of remote
10 computers to one or more user workstations allowing for
11 efficient location, error detection and/or general status
12 indication of the remote computers or servers. In
13 particular, computer interface modules connected to the
14 remote computers or servers include a signaling circuit to
15 emit a signal, which may be an audible or visual signal,
16 upon detection of a problem or upon receipt of a signal
17 command from a user trying to locate a particular remote
18 computer. Alternatively, the signaling circuit may
19 transmit a message to the user workstation to inform the
20 user of a problem, general status (e.g., of firmware
21 upgrade), etc., which may be displayed on the user's video
22 monitor.

23 In many circumstances, it is desirable to have a
24 computer workstation, which includes peripheral devices

1 such as keyboard, video monitor and cursor control devices,
2 from the computer due to space constraints. However,
3 separating a computer from its peripheral devices may make
4 it difficult to locate a particular remote computer,
5 especially in a room of hundreds or even thousands of
6 computers. Generally, there are no means for
7 differentiating between computers in such an environment
8 without any attached peripheral devices.

9 The present invention provides a simple and effective
10 means for locating a single remote computer in field of
11 many remote computers in an intelligent, modular computer
12 management system that enables several simultaneous users
13 to access and control these remote computers from one or
14 more user stations. Such a device allows, for example, a
15 system administrator to locate any one of a plurality of
16 remotely located system computers from a user or
17 administrator's station.

18 The present invention also provides compatibility
19 between various operating systems and/or communication
20 protocols. The present invention allows the same set of
21 local peripheral devices to access, control, and locate
22 remote computers executing a variety of operating systems
23 and protocols, including but not limited to, those
24 manufactured by Microsoft Corporation (Windows), Apple

1 Computer, Inc. (Macintosh), Sun Microsystems, Inc. (Unix),
2 Digital Equipment Corporation, Compaq Computer Corporation
3 (Alpha), International Business Machines (RS/6000),
4 Hewlett-Packard Company (HP9000) and SGI (formerly "Silicon
5 Graphics, Inc.").

6 Additionally, local devices may communicate with
7 remote computers via a variety of protocols including, but
8 not limited to Universal Serial Bus ("USB"), American
9 Standard Code for Information Interchange ("ASCII"), and
10 Recommend Standard-232 ("RS-232").

11 A variety of cabling mechanisms may be used to connect
12 the local user workstations and the remote computers to the
13 computerized switching system of the present invention.
14 Preferably, the present invention incorporates a single
15 Category 5 Universal Twisted Pair ("CAT 5") cable to
16 connect each local user station (each having the necessary
17 peripheral devices) and each remote computer interface
18 modules (each being connected to a remote computer) to the
19 central switch of the system. However, other cabling may
20 be used without departing from the spirit of the present
21 invention.

22 Furthermore, to achieve the desired administration
23 efficiency, the present invention provides circuitry for
24 locating a specific remote computer, detecting a remote

1 computer or computer interface module error, or identifying
2 some other issue for which a user or administrator should
3 be notified, and alerting (via a visual or audible signal)
4 the administrator or other user of such location, error or
5 other issue. Such an alert may also be utilized to notify
6 a system administrator about the status of common
7 maintenance tasks performed on the remote computer, such a
8 as a firmware upgrade.

9 Therefore, it is an object of the present invention to
10 provide a remote computer management system that allows a
11 system administrator to efficiently locate a specific
12 remote computer in a field of many computers.

13 It is another object of the invention to provide a
14 remote computer management system that comprises circuitry
15 for providing an audible or visual signal in response to a
16 user's command or in response to the detection of a remote
17 computer error or in response to detection of maintenance
18 operations such as firmware upgrades to alert the user of
19 such error or maintenance.

20 It is still another object to provide a remote
21 computer management system that comprises circuitry that
22 provides specific alerts for specific issues. Such a
23 signal may include different colored signals or different
24 audible signals for errors than for maintenance, altering

1 the flashing of visual or audible signals to identify
2 specific errors or maintenance issues, etc.

3 It is yet another object of the invention to allow
4 information technology (IT) personnel to more efficiently
5 manage a volume of servers for both small-scale and large-
6 scale computer centers such as data-centers, server-farms,
7 web-hosting facilities and call-centers.

8 In addition, it is an object of the present invention
9 to provide a remote computer management system that
10 minimizes the space required to house the computers,
11 peripheral devices and the overall computer management
12 system while providing means to locate a particular
13 computer at any time.

14 It is also an object of the present invention to
15 provide a remote computer management system comprising
16 circuitry for providing automatic signal tuning to amplify
17 and condition signals uniformly during transmission over an
18 extended range.

19 Other objects, features, and characteristics of the
20 present invention, as well as the methods of operation and
21 functions of the related elements of the structure, and the
22 combination of parts and economies of manufacture, will
23 become more apparent upon consideration of the following

1 detailed description with reference to the accompanying
2 drawings, all of which form a part of this specification.

3

4 BRIEF DESCRIPTION OF THE DRAWINGS

5 A further understanding of the present invention can
6 be obtained by reference to a preferred embodiment set
7 forth in the illustrations of the accompanying drawings.
8 Although the illustrated embodiment is merely exemplary of
9 systems for carrying out the present invention, both the
10 organization and method of operation of the invention, in
11 general, together with further objectives and advantages
12 thereof, may be more easily understood by reference to the
13 drawings and the following description. The drawings are
14 not intended to limit the scope of this invention, which is
15 set forth with particularity in the claims as appended or
16 as subsequently amended, but merely to clarify and
17 exemplify the invention.

18 For a more complete understanding of the present
19 invention, reference is now made to the following drawings
20 in which:

21 FIG. 1 is a schematic representation of the preferred
22 embodiment of a remote computer management switching system
23 according to the invention illustrating the connection of a
24 plurality of workstations (including a keyboard, video

1 monitor, and cursor control device) with a plurality of
2 remote computers, wherein the system includes a signaling
3 circuit to alert the user to the location, error,
4 maintenance status, etc, of a particular remote computer.

5 FIG. 2A is a schematic representation of the preferred
6 embodiment of the user station device ("UST") shown in FIG.
7 1 and its attached peripheral devices, illustrating the
8 internal structure of the UST and its connection to the
9 peripheral devices.

10 FIG. 2B is a schematic diagram of the preferred
11 embodiment of the automatic tuning circuit contained in the
12 UST of FIG. 2A, which functions to compensate for reduced
13 amplitudes and attenuated frequencies of the transmitted
14 signals.

15 FIG. 3 is a schematic representation of the preferred
16 embodiment of the matrix switching unit ("MSU") shown in
17 FIG. 1 illustrating via a block diagram the internal
18 structure of the MSU and its ports for any connecting
19 cables.

20 FIG. 4A is a schematic representation of the preferred
21 embodiment of the computer interface modules ("CIMs") shown
22 in FIG. 1 illustrating the internal structure of the CIM
23 including circuitry utilized for the remote location, alert
24 and management features of the present invention.

1 FIG. 4B is a circuit diagram of the preferred
2 embodiment of the signaling circuit contained within the
3 CIM for performing the remote location and alert functions
4 in accordance with the present invention.

5 FIG. 5 is a diagram of a data packet used to transmit
6 data in the system according to the invention.

7 FIG. 6 is a schematic representation of an alternate
8 configuration of a remote computer management system
9 according to the present invention illustrating connection
10 of sixteen (16) user workstations and multiple remote
11 computers to two MSUs for accommodating as many as thirty-
12 two (32) remote computers.

13 FIG. 7 is a schematic representation of yet another
14 alternate configuration of a remote computer management
15 system in accordance with the present invention
16 illustrating connection of multiple user workstations and
17 multiple remote computers to multiple MSUs for
18 accommodating as many as sixty-four (64) user workstations
19 and ten thousand (10,000) remote computers.

20

21 **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

22 As required, a detailed illustrative embodiment of the
23 present invention is disclosed herein. However,
24 techniques, systems and operating structures in accordance

1 with the present invention may be embodied in a wide
2 variety of forms and modes, some of which may be quite
3 different from those in the disclosed embodiment.
4 Consequently, the specific structural and functional
5 details disclosed herein are merely representative, yet in
6 that regard, they are deemed to afford the best embodiment
7 for purposes of disclosure and to provide a basis for the
8 claims herein, which define the scope of the present
9 invention. The following presents a detailed description
10 of the preferred embodiment (as well as some alternative
11 embodiments) of the present invention.

12 Referring first to FIG. 1, depicted is the
13 architecture of the preferred computer management system in
14 accordance with the present invention. Specifically, a
15 modular, intelligent, computer management system is shown
16 including a centrally located matrix switching unit (MSU)
17 112, multiple user stations (USTs) 108, having attached
18 keyboards 102, video monitors 104, and cursor control
19 devices 106, and multiple computer interface modules (CIMs)
20 116 each connected to a remote computer 118. Each UST 108
21 and each CIM 116 is preferably connected to MSU 112 via
22 cables 110 and 114, respectively, which are preferably
23 Category 5 Universal Twisted Pair (CAT 5) cables.

1 Although single CAT 5 cabling is the preferred cabling
2 for use with the present invention, other cabling may be
3 used, such as coaxial, fiber optic or multiple CAT 5
4 cables, depending on the specific needs of the system user.
5 CAT 5 cabling is preferred because it reduces cabling cost
6 while maintaining the strength of signals that are
7 transmitted over extended distances. Additionally, the use
8 of single CAT 5 cabling minimizes the space required to
9 house the computer system and its associated wiring.
10 Alternatively, the cables described for use with the
11 invention may be replaced with a form of wireless
12 communications.

13 Individual CAT 5 cables may be used for connection of
14 each UST 108 and each CIM 116 to MSU 112. Conventional CAT
15 5 cables include four (4) twisted pair of wires. The
16 present invention utilizes three (3) of these twisted pair
17 for the transmission of video signals. Each of the three
18 (3) twisted pair transmits one of the three video color
19 signals (i.e., red, green or blue). To allow all video
20 signals to be transmitted via only (3) twisted pair, the
21 horizontal and vertical synchronization signals, which
22 would otherwise require their own twisted pairs, are
23 individually encoded on one of the three color video
24 signals. That is, each synchronization signal is encoded

1 on its own, dedicated color signal. For example, the
2 vertical synchronization signal may be encoded on the blue
3 video signal while the horizontal synchronization signal
4 may be encoded on the green video signal. All other non-
5 video signals such as keyboard, cursor control device, and
6 audio signals, are transmitted via the fourth twisted pair
7 cable.

8 Cables 110 and 114 are connected to UST 108, MSU 112
9 and CIM 116 by plugging each end into a RJ-45 connector
10 located on these respective components to be coupled by
11 cables 110 and 114. Although RJ-45 connectors are
12 preferred, other types of connectors may be used, including
13 but not limited to RJ-11, RG-58, RG-59, British Naval
14 Connector ("BNC"), and ST connectors.

15 The remote computer management system includes local
16 user workstations 100, each preferably comprising dedicated
17 peripheral devices such as keyboard 102, video monitor 104
18 and/or cursor control device 106. Other peripheral devices
19 may also be located at workstation 100, such as printers,
20 scanners, video camera biometric scanning devices,
21 microphones, etc. Each peripheral device is directly or
22 indirectly connected to UST 108, which is attached to MSU
23 112 via cable 110. Of course, wireless peripheral devices
24 may also be used with this system. During operation, all

1 electronic signals received at UST 108 from attached
2 peripheral devices are transmitted to MSU 112 via cable
3 110. Thereafter, the signals are transmitted to the
4 desired CIM 116 via another cable 114. CIM 116, being
5 coupled to a remote computer 118, transmits the received
6 signals to the respective ports of the remote computer 118.

7 Preferably, each CIM 116 incorporates signaling
8 circuitry that automatically causes CIM 116 to emit an
9 audible or visual signal, for example, to locate a desired
10 remote CIM 116 which may be among hundreds or even
11 thousands of CIMs. Alternatively, the signaling circuitry
12 may enable a user at a user station to cause CIM 116 to
13 emit an audible or visual signal, or to transmit a signal
14 to the user station for display on the user's monitor.
15 This circuitry is also preferably configured to notify the
16 remote user about the status of the remote computer to
17 which the CIM is attached, problems with the remote
18 computer, the need for a firmware upgrade, etc.
19 Notification from the circuitry may take the form of an
20 audible or visual signal at the CIM's location or may
21 include the transmission of signals back to the user
22 station for display on a monitor.
23 Preferably, CIM 116 is compatible with all commonly
24 used, present day computer operating systems and protocols,

1 including but not limited to those manufactured by
2 Microsoft (Windows), Apple (Macintosh), Sun (Unix), DEC,
3 Compaq (Alpha), IBM (RS/6000), HP (HP9000) and SGI.
4 Additionally, local devices may communicate with remote
5 computers via a variety of protocols including Universal
6 Serial Bus ("USB"), American Standard Code for Information
7 Interchange ("ASCII") and Recommend Standard-232 ("RS-
8 232").

9 The remote computer management system of the present
10 invention may also be configured to connect varying
11 quantities of user workstations 100 with varying quantities
12 of remote computers 118. Preferably, the system according
13 to the present invention allows eight (8) USTs 108 and
14 thirty-two (32) CIMs to be connected via one MSU 112 while
15 still achieving optimal signal transmission. If additional
16 USTs or CIMs must be added, the system allows a plurality
17 of MSUs 112 to be utilized to connect as many as sixty-four
18 (64) user workstations 100 and ten thousand (10,000) remote
19 computers 118.

20 Selection of a remote computer 118 from a user
21 workstation 100 may be accomplished with a variety of
22 methods. One such method is choosing a remote computer 118
23 from a menu or list displayed on the screen of the user
24 station's video monitor 104. Such a menu or list may be

1 generated by an option menu circuit within UST 108. The
2 option menu circuit may be utilized to control the
3 signaling circuitry located within CIM 116. The option
4 menu circuit and display facilitates system programming and
5 provides information useful for system operation.
6 Furthermore, multiple security features such as passwords,
7 system user histories, etc. may be implemented and operated
8 in conjunction with the option menu circuit.

9 Turning next to FIG. 2A, depicted is a schematic
10 diagram of the preferred internal structure of UST 108
11 according to the present invention. As shown, UST 108
12 interfaces keyboard 102, video monitor 104, and cursor
13 control device 106 with MSU 112 for connection to any of a
14 plurality of remote computers (see FIG. 1). Keyboard 102
15 and cursor control device 106 are connected to keyboard
16 port 300 and cursor control device port 310 of UST 108,
17 respectively, using industry standard connectors and
18 cabling. Wireless keyboards and cursor control devices may
19 also be used. Signals from keyboard 102 and cursor control
20 device 106 generated at the local user workstation are
21 received by UST CPU 308 via keyboard port 300 and cursor
22 control device port 310, respectively. Data packets
23 representing the keyboard and cursor control device
24 information in the received signals are generated by UST

1 CPU 308. The newly generated data packets are transmitted
2 to UART 306, whereupon the data packets are converted to a
3 serial format and transmitted through port 302 to MSU 112
4 via independent cable 110. It should be noted that the
5 converted data packets may alternatively be transmitted via
6 a wireless connection, thereby eliminating the need for
7 cable 110.

8 Conversely, keyboard and cursor control device signals
9 received from the remote computer through MSU 112 via cable
10 110 are received via port 302. Thereafter, UART 306 de-
11 serializes the serial data packet signals and transmits
12 them to UST CPU 308. Alternatively, a non-UART device may
13 be used to de-serialize the received serial data packets.
14 UST CPU 308 then uses the information contained in the data
15 packet signals to emulate keyboard and cursor control
16 device signals. These emulated signals are applied to
17 keyboard 102 and cursor control device 106 via keyboard
18 port 300 and cursor control device port 310, respectively.

19 Unidirectional video signals generated at the remote
20 computer are also received at port 302 from MSU 112 via
21 communication link 110. However, these video signals are
22 transmitted to tuning circuit 304, which conditions the
23 video signals to a desired amplitude and frequency. As
24 shown in FIG. 2B, tuning circuit 304 preferably comprises

1 red variable gain amplifier 610a, green variable gain
2 amplifier 610b, blue variable gain amplifier 610c, red
3 frequency compensation amplifier 612a, green frequency
4 compensation amplifier 612b, blue frequency compensation
5 amplifier 612c, slow peak detector 614, voltage source 616,
6 comparator 618, slow peak detector 624, voltage source 626,
7 comparator 628, video switch 630, fast peak detector 632,
8 and comparator 634.

9 During operation, the keyboard, video, and cursor
10 control device signals from remote computer 118 are
11 transmitted via communication link 418 to CIM 116 (FIGS. 1
12 and 4). Thereafter, the video signals and data packets
13 generated by CIM CPU 406 are transmitted from CIM 116 to
14 MSU 112 via communication link 114 (FIGS. 1 and 4). At
15 this point in the video signal transmission, the amplitudes
16 of the transmitted video signals may be significantly
17 reduced while the frequencies of the video signals may be
18 attenuated. Subsequently, the video signals and the
19 signals generated by MSU CPU 212 (FIG. 3) are transmitted
20 from MSU 112 to UST 108, wherein the video signals are
21 conditioned by tuning circuit 304. Tuning circuit 304 is
22 implemented to automatically tune the received signals to
23 achieve the desired amplitude and frequency.

1 In the preferred embodiment, the horizontal
2 synchronization signal is encoded on and transmitted with
3 the green video signal, and the vertical synchronization
4 signal is encoded on and transmitted with the blue video
5 signal. However, the horizontal and vertical
6 synchronization signals may be encoded on and transmitted
7 with any one of the red, green, or blue video signals.
8 Also, it is preferable that the horizontal and vertical
9 synchronization signals are encoded as negative pulses,
10 since the video signals (i.e., red, green, and blue) are
11 typically positive pulses.

12 Tuning circuit 304 contains three dedicated signal
13 conditioning circuits (i.e., one for each of the red, blue,
14 and green video color signals), a gain amplification
15 adjustment circuit 615, a frequency compensation
16 amplification adjustment circuit 635, and an additional
17 filtering enablement circuit 625.

18 In operation, the red component of the video signals
19 is initially transmitted to red variable gain amplifier
20 610a and red variable frequency compensation amplifier
21 612a. Preferably, red variable gain amplifier 610a adjusts
22 the amplitude of the red component of the video signals
23 based upon the output of gain amplification adjustment
24 circuit 615. Concurrently, red variable frequency

1 compensation amplifier 612a adjusts the frequency of the
2 red component of the video signals based upon the output of
3 frequency compensation amplification adjustment circuit
4 635. The outputs of red variable gain amplification
5 circuit 610a and red frequency compensation circuit 612a
6 are electrically combined and transmitted via wire 622 to
7 video port 312 for transmission to video monitor 104.

8 The green component of the video signals, with the
9 encoded horizontal synchronization signal, is initially
10 transmitted to green variable gain amplifier 610b and green
11 variable frequency compensation amplifier 612b. The two
12 outputs are then electrically combined and transmitted to
13 gain amplification adjustment circuit 615 and frequency
14 compensation amplification adjustment circuit 635. Gain
15 amplification circuit 615 comprises slow peak detector 614
16 that receives the electrically combined outputs of green
17 variable gain amplifier 610b and green variable frequency
18 compensation amplifier 612b. Slow peak detector 614
19 detects the amplitude of the horizontal synchronization
20 signal, which is encoded on the green component of the
21 video signals, and transmits a signal representing this
22 amplitude to comparator 618 and comparator 634. Comparator
23 618 then compares the signal received from slow peak
24 detector 614 to a constant reference voltage supplied by

1 voltage source 616. The signal supplied by voltage source
2 616 represents the desired amplitude for the horizontal
3 synchronization signal. Next, comparator 618 transmits a
4 signal to red variable gain amplifier 610a, green variable
5 gain amplifier 610b, and blue variable gain amplifier 610c
6 to adjust the level of amplification of the red, green, and
7 blue components of the video signals until the desired
8 amplitude is achieved.

9 Similarly, green variable frequency compensation
10 amplifier 612b adjusts the level of amplification of the
11 frequency of the horizontal synchronization signal based
12 upon the output of frequency compensation amplification
13 adjustment circuit 635. Frequency compensation
14 amplification adjustment circuit 635 comprises fast peak
15 detector 632 that also receives the electrically combined
16 outputs of green variable gain amplifier 610b and green
17 variable frequency compensation amplifier 612b. Fast peak
18 detector 632 detects the rising edge of the horizontal
19 synchronization signal and transmits a signal representing
20 this rising edge to comparator 634. Then, comparator 634
21 compares the signal received from fast peak detector 632 to
22 the output of slow peak detector 614 to compare the
23 amplitude of the rising edge of the horizontal
24 synchronization signal pulse to the amplitude of the

1 horizontal synchronization signal pulse itself. Next,
2 comparator 634 sends a signal that is fed to red variable
3 frequency compensation amplifier 612a, green variable
4 frequency compensation amplifier 612b, and blue variable
5 frequency compensation amplifier 612c to adjust the level
6 of amplification of the red, green, and blue components of
7 the video signals until the desired frequency is achieved.
8 Optionally, the signal transmitted by comparator 634 may be
9 manually adjusted using manual input 633 by a system
10 administrator (e.g., using the option menu discussed above
11 or controls located on the exterior of the UST). Such a
12 feature would allow the system user to manually "tweak" the
13 gain of the video signals until a desired video output is
14 achieved.

15 The blue component of the video signals, along with
16 the encoded vertical synchronization signal, is initially
17 transmitted to blue variable gain amplification circuit
18 610c, blue variable frequency compensation circuit 612c,
19 and filtering enablement circuit 625, which is employed to
20 increase the range of red variable frequency compensation
21 amplifier 612a, green variable frequency compensation
22 amplifier 612b, and blue variable frequency compensation
23 amplifier 612c when the video signals have been transmitted
24 over approximately four hundred fifty (450) feet. The

1 vertical synchronization signal, which is encoded on the
2 blue component of the video signals as a precise square
3 wave signal of known duration and amplitude, is used as a
4 precise reference point for filtering enablement circuit
5 625. The blue component of the video signals and the
6 encoded vertical synchronization signal are received by
7 slow peak detector 624, which detects the amplitude of the
8 vertical synchronization signal. Slow peak detector 624
9 transmits a signal representing the amplitude of the
10 vertical synchronization signal to comparator 628, which
11 compares it to the known amplitude of a similar signal
12 transmitted for four hundred fifty (450) feet. This known
13 amplitude is represented by a constant reference voltage
14 applied to comparator 628 by voltage source 626. If
15 comparator 628 determines that the vertical synchronization
16 signal (and therefore all of the video signals) have been
17 transmitted over four hundred fifty (450) feet, a signal
18 indicating this is transmitted to video switch 630. Video
19 switch 630 then sends a signal to red variable frequency
20 compensation amplifier 612a, green variable frequency
21 compensation amplifier 612b, and blue variable frequency
22 compensation amplifier 612c to increase the range of each
23 frequency compensation amplifier 612a, 612b, and 612c.

1 Subsequent to the amplification by gain amplification
2 adjustment circuit 615 and the frequency compensation by
3 frequency compensation amplification adjustment circuit
4 635, the conditioned red, green, and blue components of the
5 video signals are transmitted to video switch 314.
6 Thereafter, video switch 314 determines whether to transmit
7 the video signals received from tuning circuit 304 (i.e.,
8 the video signals received from one of the remote computers
9 118) or the video signals received from option menu circuit
10 318 to video amplifier 316. Finally, the amplified video
11 signals are transmitted via port 312 for display on video
12 monitor 104.

13 Turning next to FIG. 3, depicted is a schematic
14 representation of the preferred embodiment of MSU 112.
15 According to the invention, MSU 112 enables multiple users
16 to access and operate a plurality of remote computers.
17 Access by a user to one of the remote computers from a
18 local user workstation is performed completely via one or
19 more MSUs 112, independent of any network that may couple
20 the remote computers to each other such as a Local Area
21 Network, Wide Area Network, etc. In other words, the
22 computer management system of the present invention does
23 not utilize an existing computer network to allow a local
24 user workstation to control the remote computers. Rather,

1 all physical connections between the local user workstation
2 and the remote computers occur through MSU 112.

3 In the preferred embodiment, MSU 112 comprises a
4 plurality of CIM ports 202 that are preferably RJ-45
5 sockets, which allow each CIM 116 to be connected to MSU
6 112 via an independent communication link 114 (FIG. 1).
7 The uni-directionally transmitted (i.e., from the remote
8 computer to the user workstation only) video signals are
9 received at MSU 112 through CIM ports 202 onto video bus
10 222, whereupon the video signals are transmitted to video
11 differential switch 206. Video differential switch 206 is
12 capable of transmitting any video signals received from
13 video bus 222 to any UST port 216. The transmitted video
14 signals are then transmitted via independent communication
15 link 110 to attached UST 108 (FIG. 1).

16 In addition to transmitting the unidirectional video
17 signals, MSU 112 bi-directionally transmits keyboard and
18 mouse signals between USTs 108 and CIMs 116 (FIG. 1). When
19 transmitting the signals from one CIM 116 to one UST 108,
20 these signals are received through CIM ports 202 on
21 peripheral bus 220, whereupon they are transmitted to
22 peripheral switch 214. Thereafter, peripheral switch 214
23 transmits these signals to the appropriate CIM universal
24 asynchronous receiver transmitter ("UART") 241, which de-

1 serializes the signals (i.e., converts the signals from a
2 serial format to a format that is compatible with the MSU
3 CPU 112, e.g., parallel format) and transmits them to
4 central MSU processing unit ("CPU") 212. MSU CPU 212
5 analyzes the received signals and generates a new data
6 packet based upon command information contained within the
7 received signals. The new data packet is transmitted to
8 the appropriate UST UART 230. UST UART 230 then serializes
9 the signals and transmits them to the appropriate UST port
10 216 for transmission via independent communication link 110
11 to the appropriate UST 108 (FIG. 1).

12 Conversely, MSU 112 also transmits keyboard and mouse
13 signals received at one UST 108 to one CIM 116 connected to
14 a remote computer 118 (FIG. 1). In this aspect, the
15 keyboard and mouse signals are received at UST 108 and
16 transmitted via communication link 110 to the respective
17 UST port 216 located at MSU 112. Thereafter, these signals
18 are transmitted to UST UART 230, which de-serializes the
19 signals and transmits them to MSU CPU 212. MSU CPU 212
20 interprets the information contained in the data packets of
21 the received signals to create new signals, which also
22 represent newly generated data packets. These new signals
23 are then transmitted to the CIM UART 241 that is associated
24 with the desired remote computer 118. CIM UART 241

1 serializes the signals and transmits them to peripheral
2 switch 214, which transmits the signals to the desired CIM
3 port 202 via peripheral bus 220. Subsequently, the
4 keyboard and mouse signals are transmitted via
5 communication link 114 to the appropriate CIM 116, which is
6 connected to the desired remote computer 118 (FIG. 1).

7 Turning next to FIG. 4A, shown is a schematic diagram
8 of CIM 116. Preferably, each CIM 116 contains signaling
9 circuit 418 which enhances remote administration by
10 allowing a remote user to easily locate a particular CIM
11 and remote server in an extensive server farm. The
12 signaling circuit may be used for other administrative
13 functions such as notifying a user about the status of a
14 firmware upgrade, detecting malfunctions, etc.

15 CIM 116 may be compatible with any present day
16 computer system, including but not limited to those
17 manufactured by Microsoft (Windows), Apple (Macintosh), Sun
18 (Unix), DEC, Compaq (Alpha), IBM (RS/6000), HP (HP9000) and
19 SGI. However, it is foreseeable that the technology of the
20 present invention will also be compatible with those
21 computer systems not yet contemplated.

22 CIM 116 interfaces video port 412, keyboard port 414
23 and cursor control device port 416 of remote computer 118
24 to MSU 112 via CAT 5 cable 418 and port 400. CIM 116

1 transmits video signals uni-directionally from remote
2 computer 118 to MSU 112. However, as discussed previously,
3 keyboard and cursor control device signals may be
4 transmitted bi-directionally between remote computer 118
5 and MSU 112.

6 During operation, video signals are transmitted from
7 video port 412 of remote computer 118 to port 400 of CIM
8 116 via cable 418. From port 400, the unidirectional video
9 signals are transmitted to video driver 404, which converts
10 the standard red, green and blue video signals to a
11 differential signal for transmission through port 402 to
12 MSU 112 via cable 114. Each color signal is transmitted
13 via its own twisted pair of wires contained within cable
14 114 (when transmitted from CIM 116 to MSU 112) or cable 110
15 (when transmitted from MSU 112 to UST 108) (FIG. 1).
16 Furthermore, video driver 404 appends the horizontal and
17 vertical synchronization signals to one of the red, green
18 or blue video signals to allow all five components of the
19 video signals to be transmitted via only three twisted pair
20 of wires of cables 110 or 114. That is, the horizontal and
21 vertical synchronization signals are each transmitted on
22 its own color signal -- not the same color signal.
23 In contrast, keyboard and cursor control device
24 signals generated at remote computer 118 are received by

1 CIM CPU 406 from keyboard port 414 and cursor control
2 device port 416, respectively, via communication link 418
3 and port 400. Data packets representing the keyboard and
4 cursor control device information in the received signals
5 are generated by CIM CPU 406. The newly generated data
6 packets are transmitted to UART 408, which serializes the
7 signals and transmits them via communication link 114 to
8 MSU 112 through port 402.

9 If the keyboard and cursor control device signals
10 comprise a signaling control signal, CIM CPU 406 causes
11 signaling circuit 418 to emit an audible or visual signal.
12 That is, CIM CPU 406 contains all the required firmware to
13 control signaling circuit 418. Preferably, as shown in
14 FIG. 4A, signaling circuit 418 comprises amplification
15 circuit 420, signaling 422, and ground 423. A signaling
16 circuit control signal received from CIM CPU 406 is
17 transmitted to amplification circuit 420 where the signal
18 is amplified utilizing a transistor amplification circuit
19 comprising resistors 424a, 424b and 424c, voltage source
20 426, and transistor 428. By utilizing proper combinations
21 of resistances for resistors 424a, 424b, and 424c and
22 voltage value for voltage source 426, the signaling circuit
23 control signal achieves the desired amplification. The
24 amplified control signal is then sent to signaling 422

1 which emits an audible or visual signal in response.

2 Signaling circuit 418 is completed by ground connection
3 423.

4 In the preferred embodiment, the signaling circuit
5 control signal is a 2.7 kHz square wave, which causes
6 signaling circuit 418 to emit the audible or visual signal.
7 However, the signaling circuit control signal may be a
8 waveform of any frequency or shape sufficient to cause
9 signaling 422 to emit an audible or visual signal.

10 Alternatively, the frequency or shape may be specifically
11 chosen to emit a particular audible or visual signal from
12 signaling device 422.

13 Signaling circuit 418 may be utilized for a number of
14 useful functions. If a remote user wishes to locate a
15 certain remote computer with an attached CIM 116, the user
16 utilizes the keyboard and/or cursor control device to send
17 a signaling circuit control signal to the desired remote
18 CIM 116, thereby causing signaling circuit 418 to emit an
19 audible or visual signal. The user may then locate the
20 remote CIM 116 by locating the source of the audible signal
21 produced by signaling circuit 418.

22 Signaling circuit 418 may also be utilized to notify a
23 remote user of the status of a user initiated CIM firmware
24 upgrade. As an example, signaling circuit 418 may

1 initially beep or flash slowly during the early phases of a
2 firmware upgrade and beep or flash more frequently as the
3 firmware upgrade nears completion. To indicate the end of
4 the firmware upgrade, signaling circuit 418 may produce a
5 pre-programmed series of beeps or flashes to indicate
6 completion of the upgrade. If the firmware upgrade is
7 unsuccessful, signaling circuit 418 may beep continuously
8 until a user completes the firmware upgrade. CIM CPU 406
9 may also include firmware that causes signaling circuit 418
10 to produce an audible or visual signal in the event that
11 CIM 116 experiences an error (e.g., the computer locks up).

12 Furthermore, signaling circuit 418 may be controlled
13 utilizing an on-screen menu accessible at the remote user
14 station. Access to the control of signaling circuit 418
15 may optionally be password protected.

16 Conversely, keyboard and cursor control device signals
17 received from the local user workstation through MSU 112
18 and cable 114 (FIG. 1) are received at port 402. data
19 packet signals and transmits them to CIM CPU 406.
20 Alternatively, the received data packet signals may be de-
21 serializes by a non-UART device. CIM CPU 406 uses the
22 information contained in the data packet signals to emulate
23 keyboard and mouse signals. These emulated signals are

1 applied to keyboard port 414 and mouse port 416 through
2 port 400 via cable 418.

3 Furthermore, CIM 116 contains memory unit 410, which
4 stores identification information for CIM 116 and its
5 connected remote computer 118 including their assigned
6 name, group, address, etc. Thus, if a specific remote
7 computer 118 is not functioning properly, it is easy to
8 assess which remote computer 118 has malfunctioned. In
9 addition, the CIM address facilitates proper transmission
10 of the keyboard and mouse signals since the address of the
11 desired CIM 116 is included in the keyboard and mouse data
12 packets that are generated by MSU CPU 212. For example, if
13 CIM 116 receives a data packet containing an address other
14 than the CIM's address, the data packet may be returned to
15 MSU CPU 212 for retransmission to the proper CIM 116.
16 Furthermore, memory unit 410 allows CIM 116 and its
17 connected remote computer 118 to be easily identified even
18 if it is relocated and/or connected to a new MSU 112 or a
19 new port of the same MSU 112. Upon reconnection of CIM
20 116, MSU 112 reads the identification information stored in
21 the CIM's memory unit 410. This information allows MSU 112
22 to reconfigure or update the location of CIM 116, which
23 ensures that the system continues to properly route
24 information to CIM 116. This feature allows system

1 administrators to easily re-organize CIMS 116 and remote
2 computers 118 without re-programming the system.

3 Finally, in the preferred embodiment of the present
4 invention, remote computer 118 provides power to CIM 116,
5 thereby eliminating the equipment, cabling and space
6 required for a dedicated CIM power source.

7 Referring next to FIG. 5, provided is an example of a
8 data packet used to transmit keyboard and mouse
9 information. In the example, protocol data packet 500
10 consists of five bytes. First byte 502 comprises the
11 instructional, or command, data and data regarding the
12 total length of data packet 500. That is, the first half
13 of first byte 502 contains the command data and the second
14 half of first byte 502 contains the length data. The
15 subsequent four bytes 504 include the characters typed on
16 keyboard 102 and clicks performed with cursor control
17 device 106 (FIG. 1).

18 It is well known in the art to transmit command and
19 length data in separate bytes. Therefore, utilizing
20 conventional data packet technology, the data packet of the
21 present invention would need to contain six bytes (i.e.,
22 one byte for command data, one byte for length data and
23 four bytes for system data). In contrast, the preferred
24 embodiment of the present invention minimizes the size of

1 the data packet by combining the command and length data
2 into one byte, thereby allowing four bytes of system data
3 to be transmitted in a five-byte data packet. Consequently,
4 signal transmission in the intelligent, modular server
5 management system of the present invention is more
6 efficient, allowing a single CAT 5 cable to be used for
7 transmission of keyboard, mouse and video signals.

8 Referring next to FIG. 6, disclosed is an alternate
9 embodiment of the intelligent, modular computer management
10 system of the present invention in which the system is
11 expanded to include two MSUs 112, each having eight (8)
12 inputs and thirty-two (32) outputs. This configuration
13 allows sixteen (16) USTs 108 to access and operate thirty-
14 two (32) remote computers 118. In this alternate
15 embodiment, each UST 108 may be linked to either first MSU
16 650 or second MSU 651 via cable 110. All signals received
17 at UST 108 are transmitted via its connected MSU (i.e.,
18 either first MSU 701 or second MSU 702) to CIM 116 that is
19 connected to the desired remote computer 118. In this
20 alternate embodiment, CIM 116 provides interfaces for two
21 (2) single CAT 5 cables 114 to allow it to connect to both
22 first MSU 650 and second MSU 651. Thus, CIM 116 allows
23 sixteen (16) user workstations 100 to operate thirty-two
24 (32) remote computers 118. In addition, this embodiment

1 allows two (2) user workstations 100 to simultaneously
2 access and operate the same remote computer 118.
3 Alternatively, this embodiment allows a first user
4 workstation 100 to inform a second user workstation 100
5 that a remote computer 118 is in use and, therefore, access
6 to it is restricted.

7 Referring next to FIG. 7, disclosed is another
8 alternate embodiment of the intelligent, modular server
9 system of the present invention. The use of forty (40)
10 total MSUs (i.e., eight (8) first tier MSUs 702 and thirty-
11 two (32) second tier MSUs 704), wherein each first tier MSU
12 702 and second tier MSU 704 has eight (8) inputs and
13 thirty-two (32) outputs, allows sixty-four (64) user
14 workstations 100 to operate and access one thousand twenty
15 four (1,024) remote computers 118. In this alternate
16 embodiment, each UST 108 is directly linked to one of eight
17 (8) first tier MSUs 702 via single CAT 5 cable 706. First
18 tier MSU 702 routes all signals received from user
19 workstation 100 via single CAT 5 cable 708 to second tier
20 MSU 704 that is connected to the CIM 116 associated with
21 the desired remote computer 118. Second tier MSU 704 then
22 routes the received signals to the respective CIM 116 via
23 single CAT 5 cable 710, whereupon CIM 116 applies these
24 signals to the respective ports of remote computer 118. In

1 this embodiment, the second tier of MSUs 704 comprises
2 thirty-two (32) units. Each second tier MSU 704 is coupled
3 to multiple CIMS 116, which provide a direct interface to
4 each of the one thousand twenty four (1,024) potential
5 remote computers 118 via single CAT 5 cables 710.

6 Although FIG. 7 depicts the configuration used to
7 access and control one thousand twenty four (1,024) remote
8 computers 118 from sixty-four (64) user workstations 100,
9 many other system configurations are available to allow a
10 greater number of user workstations 100 to be connected to
11 a greater number of remote computers 118. For example, the
12 number of MSU tiers may be increased, or, alternatively,
13 hubs may be incorporated. Also, the MSUs may be designed
14 to comprise more than eight (8) inputs and more than
15 thirty-two (32) outputs.

16 Alternatively, in accordance with the present
17 invention, the signaling circuitry of the present invention
18 may be employed in further configurations of remote
19 computer management systems. For example, such a system
20 may comprise a "switch less" KVM solution that enables
21 access and control of multiple servers from a single user
22 console (keyboard, monitor, and cursor control device)
23 without the traditional KVM switch box and all the usual
24 switch-to-server cables. Such a system comprises a chain-

1 like server-to-server arrangement including only two basic
2 components: a user station and computer interface modules
3 (CIMS). The CIMS are connected to the keyboard, video, and
4 cursor control devices of each server and are connected to
5 each other with CAT 5 cables and transmit the keyboard,
6 video, and mouse signals directly to the user station. In
7 such an embodiment, the signaling circuit is structured and
8 functions in the same manner as described above.

9 While the present invention has been described with
10 reference to the preferred embodiments and several
11 alternative embodiments, which embodiments have been set
12 forth in considerable detail for the purposes of making a
13 complete disclosure of the invention, such embodiments are
14 merely exemplary and are not intended to be limiting or
15 represent an exhaustive enumeration of all aspects of the
16 invention. The scope of the invention, therefore, shall be
17 defined solely by the following claims. Further, it will
18 be apparent to those of skill in the art that numerous
19 changes may be made in such details without departing from
20 the spirit and the principles of the invention. It should
21 be appreciated that the present invention is capable of
22 being embodied in other forms without departing from its
23 essential characteristics.